Space Weather Technical Forecast

Issued on Wednesday 13 November 2024 at 12:59 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: R1/R2 likely throughout. Slight chance of G1/Minor Geomagnetic Storm intervals, mainly Day 1 (13 Nov).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate during the past 24 hours with an isolated peak M1.0 flare at 12/0022 UTC from the vicinity of AR3889.

There are now six sunspot regions on the visible disc, with AR3886 having faded. AR3889, at south centre disc, is the largest and most complex region. It consists of two main clusters of mature spots with at least one small delta region in the lead group. AR3883, close to the southwest limb, is now barely visible so the previous classification has been largely maintained as it rotates off the disc. AR3884, in the southwest, now looks to be a unipolar group. The remaining regions are relatively small and simple.

No CMEs observed over the past 24 hours are considered to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE were indicative of a slow regime, with the onset of a HSS just beginning. The wind speed varied between 330-370 km/s. Density was below average. The interplanetary magnetic field (IMF) was weak for much of the period, becoming moderate after 13/1030 UTC with a peak so far of 9nT. The north-south component, Bz, varied weakly until later in the period when it became moderately southward directed. The phi angle was mainly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was initially at mostly moderate levels, peaking at 506pfu at 12/2040 UTC. The associated 24-hour fluence has been on a slight upward trend, but remains below the Active threshold. The integrated flux observed at 13/0000UTC was 1.58e7.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated M-class flares are likely throughout the period, with a slight chance of X-class flares, mostly from AR3889.

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Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Connection to a coronal hole fast wind is expected during Day 1 (13 Nov) with slightly elevated wind speeds which could then persist for much of the period. Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp 0-3). On Day 1 (12 Nov), Unsettled to Active (Kp 3-4) conditions are possible with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp 5). During Days 2-4 there remains a very slight chance of further G1/Minor Geomagnetic Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is at background levels. There is a slight chance of S1/Minor solar radiation storms, mainly due to the potential for flaring from AR3889 as it rotates into a more geoeffective position in the western hemisphere.

The high energy electron flux may potentially rise to diurnal peaks at high levels during the period, with the associated fluence most likely persisting below Active levels but with a rising trend.

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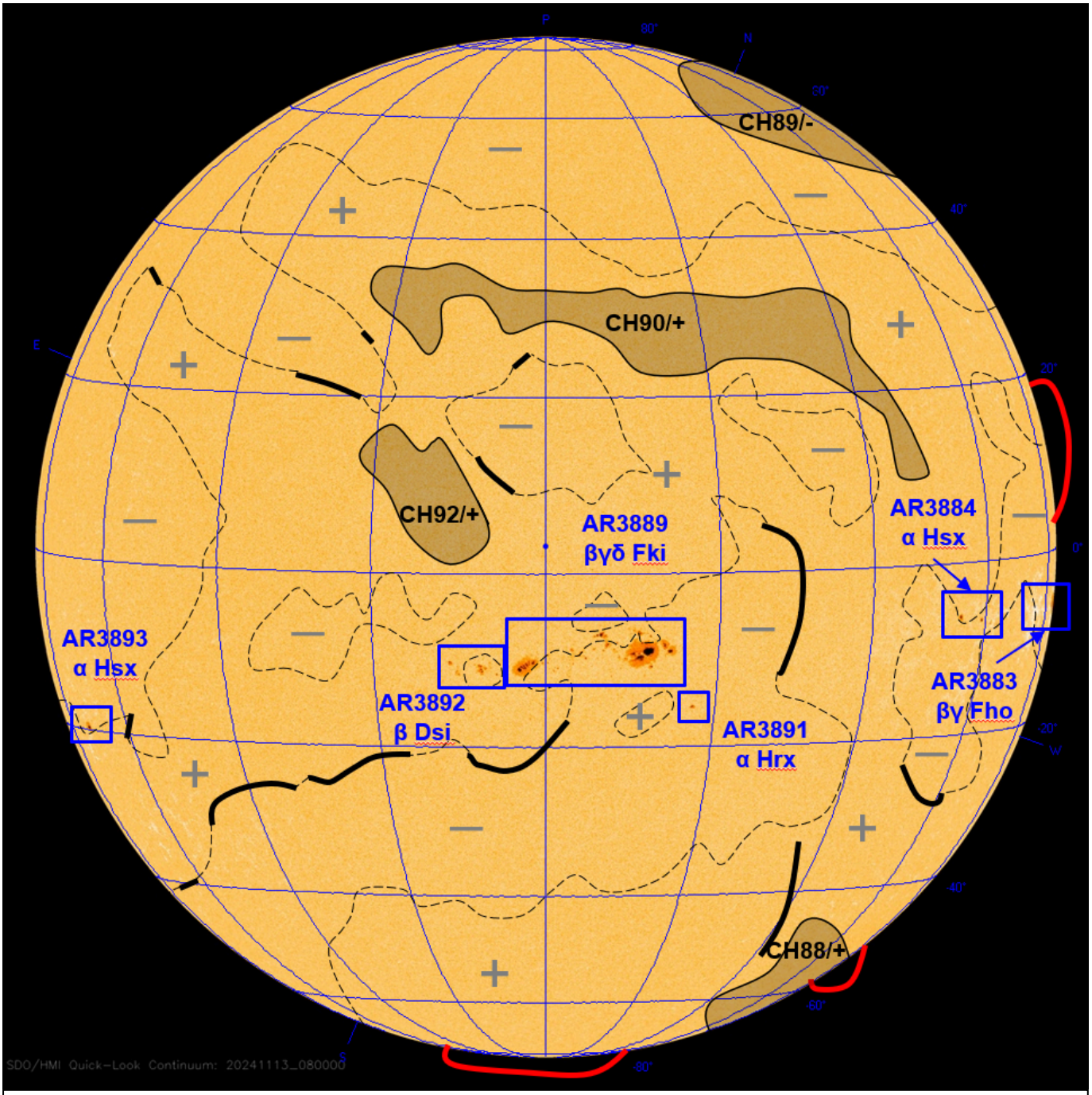
Figure 1: Solar synoptic map valid 13/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs currently feature in the forecast. One filament lift-off from the southern hemisphere on 11 Nov produced a CME around 11/1630 UTC which is expected to pass below Earth's orbit. However, a small number of Enlil ensemble members suggest some glancing enhancement on Day 2 (14 Nov) attributed to this event. There are a number of filaments which have shown signs of instability and warrant monitoring for potential sources of CMEs during the period.

The four-day forecast comprises primarily of coronal hole influences. Connection to a HSS from CH90/+ is expected during Day 1 (13 Nov) with some element of enhancement persisting through much of the forecast period. However, this feature gave only limited influence on the previous rotation, with solar winds reaching around 450-500km/s. It is in a similar position to the previous rotation, but extends further east and slightly further south. MOSWOC Enlil is not suggesting a significant connection to CH90/+, so confidence is low. Connection to a HSS from CH92/+ is possible towards the end of Day 4 (16 Nov), with CH92/+ currently located just east of centre disc.

Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp 0-3) through the period. On Day 1 (12 Nov), Unsettled to Active (Kp 3-4) conditions are possible with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp 5) following any connection to the HSS from CH90/+. During Days 2-4 there remains a very slight chance of further G1/Minor Geomagnetic Storm intervals owing to the feature's longitudinal extent.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	20	10	5	5
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2: MOSWOC Enlil, showing a limited and gradual wind speed increase in the coming days.

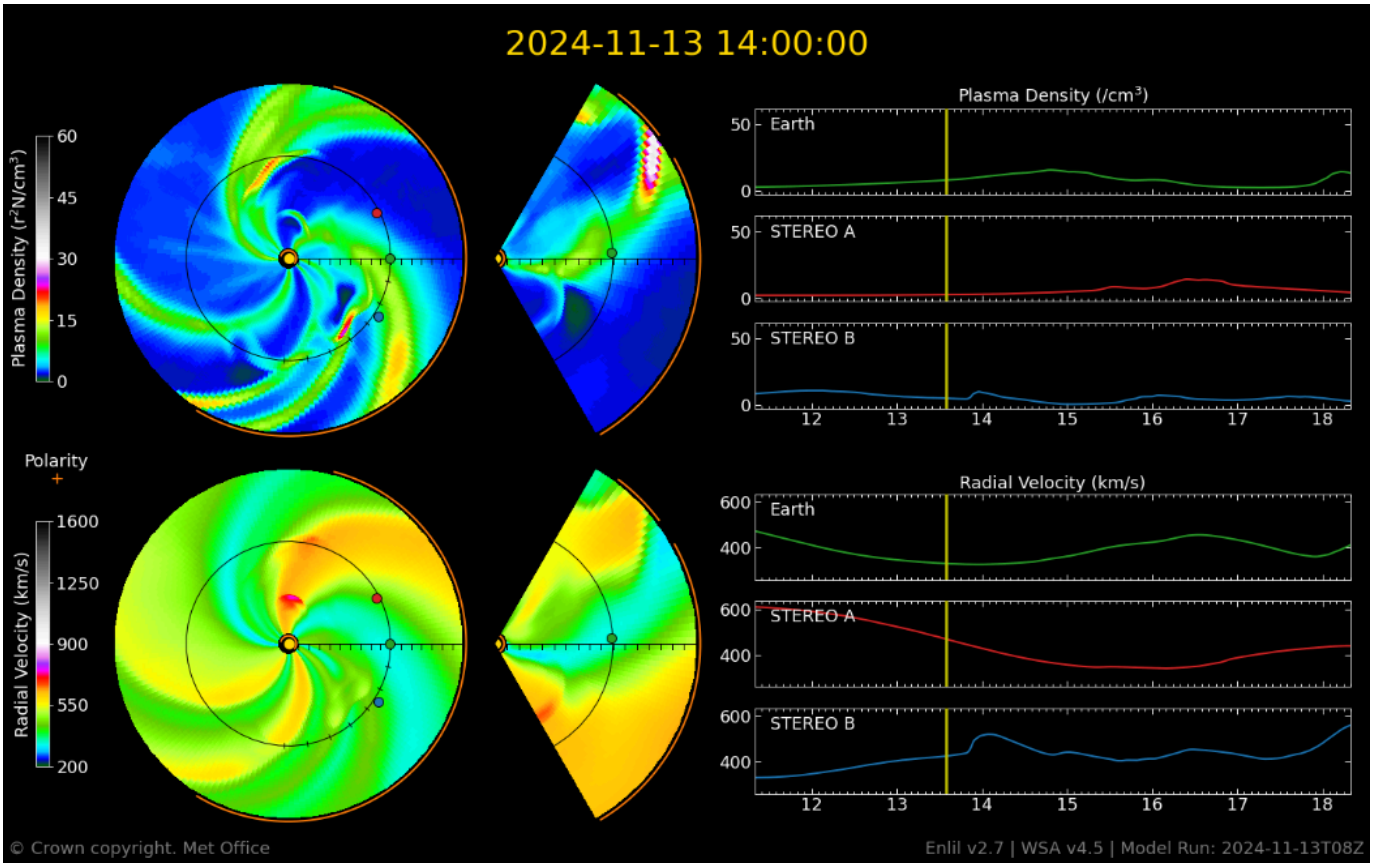

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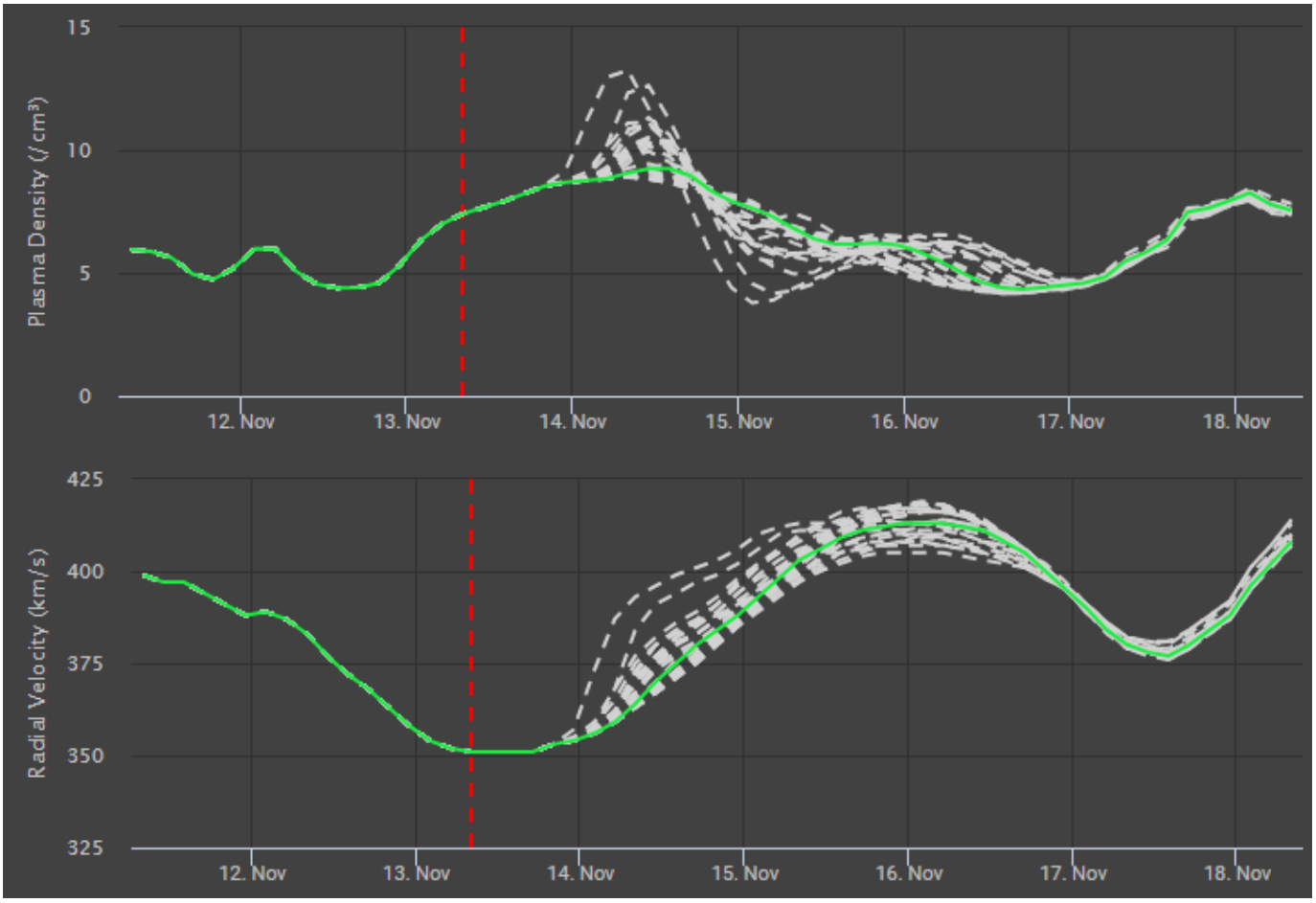
Figure 3: Enlil ensemble, showing the potential for a CME glancing blow on 14 November, although this is currently considered unlikely.



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Radio Blackouts - X-Ray Flares

Solar activity was Moderate during the past 24 hours with an isolated peak M1.0 flare at 12/0022 UTC from the vicinity of AR3889.

There are now six sunspot regions on the visible disc, with AR3886 having faded. AR3889, at south centre disc, is the largest and most complex region. It consists of two main clusters of mature spots with at least one small delta region in the lead group. AR3883, close to the southwest limb, is now barely visible so the previous classification has been largely maintained as it rotates off the disc. AR3884, in the southwest, now looks to be a unipolar group. The remaining regions are relatively small and simple.

AR3883 is due to depart the disc early on Day 2 (14 Nov), with a slight reduction in flare risk by Day 4 (16 Nov) as it rotates well away from the limb. The main flare risk comes from AR3889, however. Overall, M-flares are considered likely with a slight chance of X-flares, mainly from AR3889.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	55
Very Active	R3-R5 (X Class)	No	10	10	10	10

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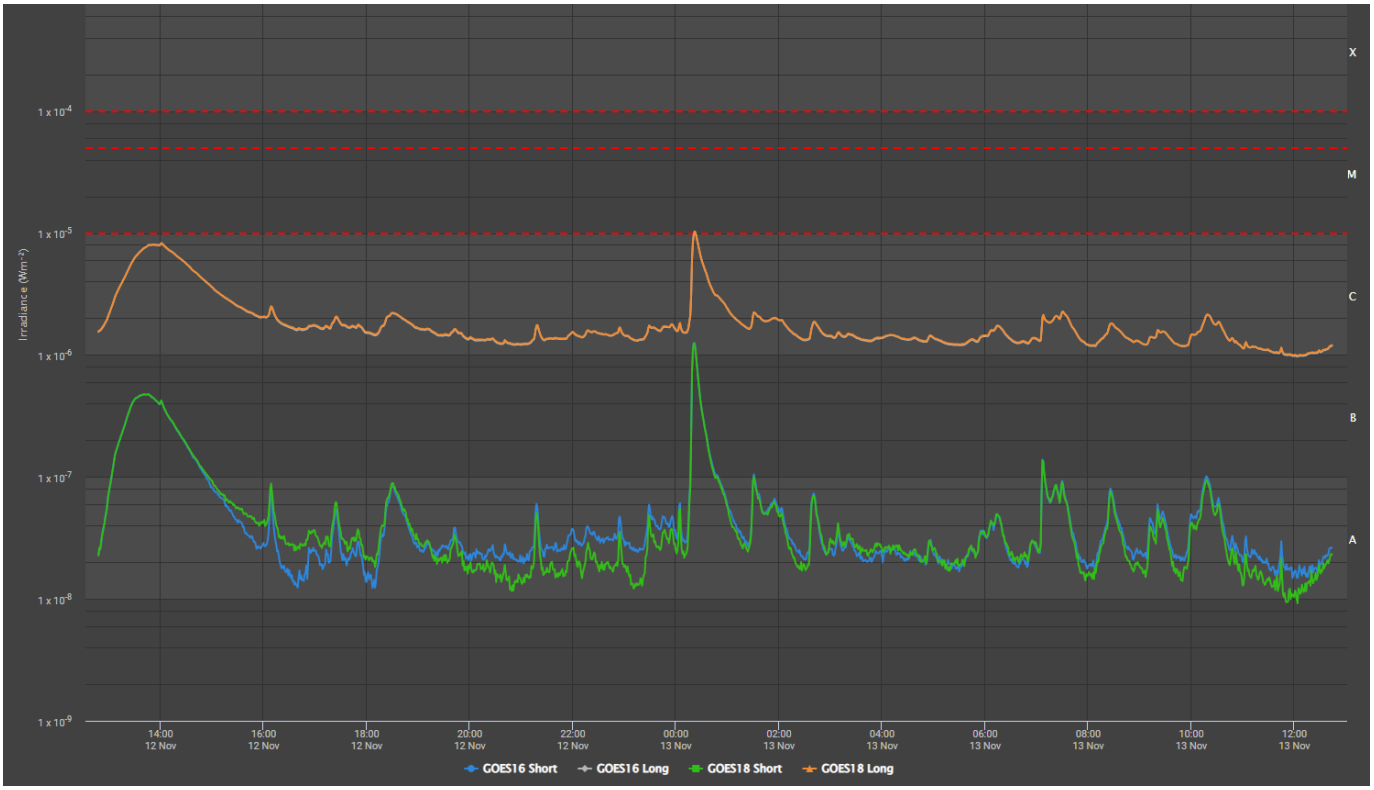
Figure 4: X-ray flux at GOES16 and 18, with just one Moderate-class flare in the last 24 hours.



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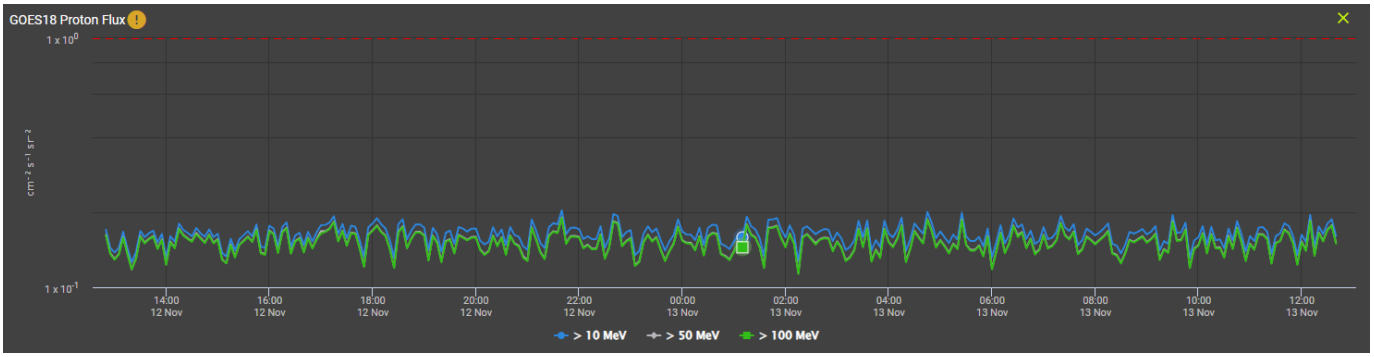
Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is at background levels and is likely to remain that way during the period in the absence of any significant flare activity.

There is a slight chance of S1/Minor solar radiation storms over the period, mainly due to any potential flaring from AR3889 as it rotates into a more geoeffective position in the western hemisphere. There is a smaller risk from AR3883, which declines later in the period as this region rotates well away from the west limb, but this is largely balanced by AR3889 rotating westwards.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: Proton flux at GOES18, which is currently at background levels.



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High Energy Electrons (≥ 2MeV)

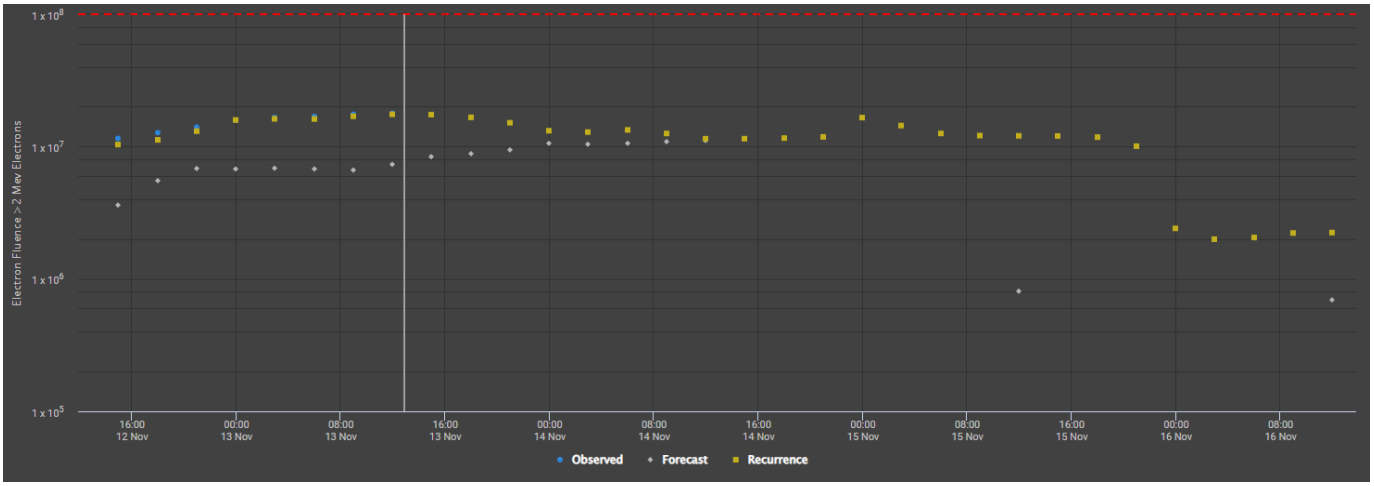
High energy electron flux (greater than 2MeV) as observed by GOES16 is at mostly moderate levels.

Persistence-wise, Earth is now approaching a period where spells of high flux are likely, with diurnal maxima reaching high levels during the last rotation of what is now CH90/+. 24-hour fluence levels are expected to remain below Active levels, although with MOSWOC REFM perhaps a little low in its forecast fluence level.

Overall, in the absence of any CME arrivals, there is a rising slight chance of Active fluence, peaking later in the period after geomagnetic activity subsides from the onset of CH90.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	5	10	15
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 6: MOSWOC REFM showing a below Active fluence forecast. This may be a bit too low by Day 3 (15 Nov).



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